

NATIONAL COMMUNICABLE DISEASE CENTER  
**SMALLPOX ERADICATION PROGRAM**

**THE SEP REPORT**

- I. SMALLPOX ERADICATION IN WEST  
AND CENTRAL AFRICA
- II. ERADICATION NOTES

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

PUBLIC HEALTH SERVICE

**PREFACE**

Summarized in this report is information pertaining to smallpox eradication and information received from Ministries of Health investigators, WHO, PAHO and other pertinent sources. Much of the information is preliminary. It is intended primarily for the use of those with responsibility for disease control activities. Anyone desiring to quote this report should contact the original investigator for confirmation and interpretation.

Contributions to the Report are most welcome.

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"Imagine the worst vaccination "take" you have ever seen—a deep, punched out, sloughing pit. Multiply this a thousandfold, until the lesions are scattered all over the body, the forehead, face, chest, back and the arms; picture them on the scrotum, the penis, and sometimes, when the oedematous eyelids are forcibly separated, on the eyeball itself. Now cover this agonized mass of sores with millions of flies crawling obscenely even into the mouths of the more weakened victims. Add to this the crying of the affected babies and the wailing of the women whose men were dying. Picture the vultures circling lazily and confidently overhead and remember always that the whole scene is set in the pitiless, scorching heat that makes even the stones on the ground too hot to touch. ... If a man were smitten with the disease and stoned from the village his entire family moved with him—his sons and daughters, wives and slaves. They moved with him to this dung-heap and there, inevitably, they contracted his disease. If a woman were infected she suffered alone: no fond husband accompanied her, no slave went with her, and she lay alone on the ground. When thirsty she crawled to the well and, when too weak to crawl, she died."

L.G.P. Shiers, Journal of the Royal Naval Medical Service,  
Volume XXXIII, Number 4, October 1947.

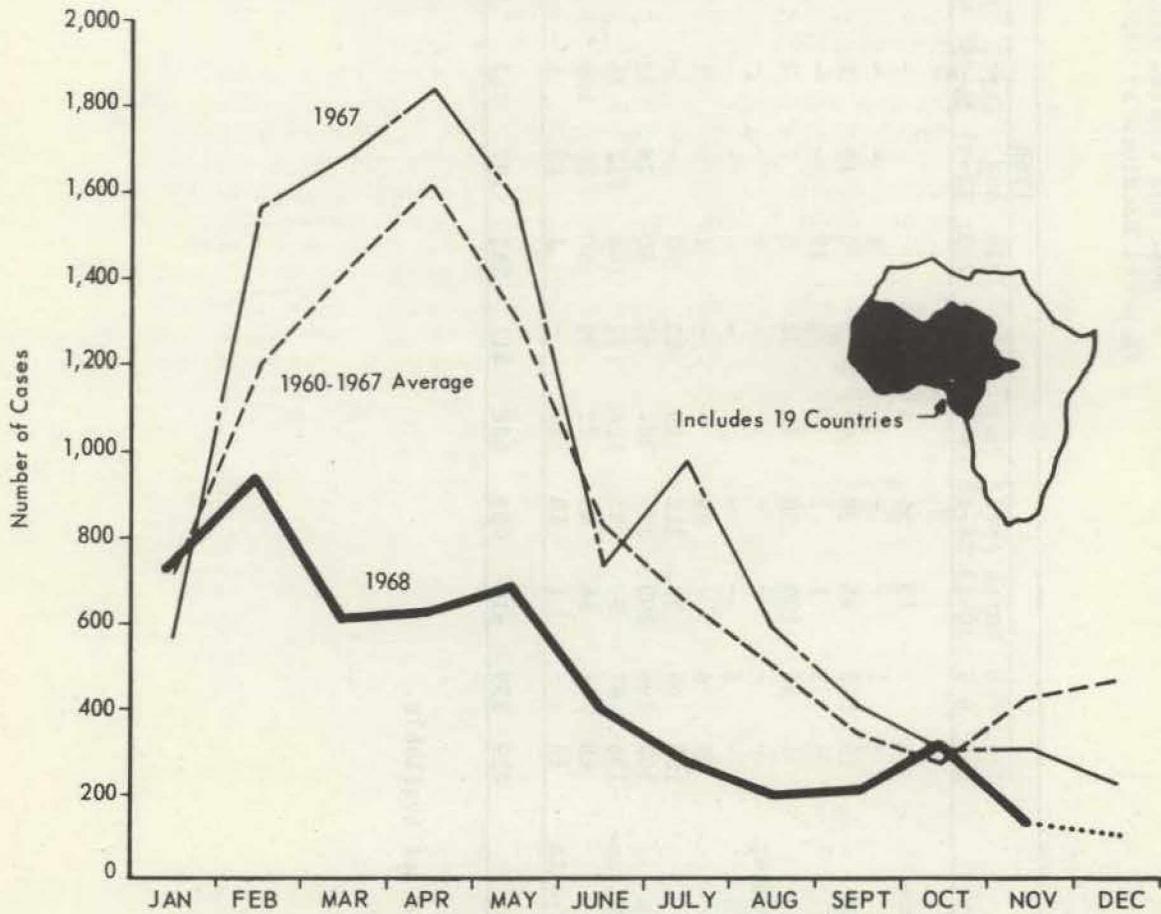
I. SMALLPOX ERADICATION IN WEST AND CENTRAL AFRICA

A. Smallpox Morbidity Data

Reports received by the World Health Organization as of January 30, 1969, show a total of 5,327 cases of smallpox throughout the 19-country area during 1968. In comparison with the 10,813 reported by the same date in 1967, these represent a decrease of 50.7 per cent (Table 1).

Figure 1 shows the monthly incidence of smallpox cases for 1967 and 1968. For 1968 a continuing decrease is observed in the number of cases, even during those months for which seasonal increases have normally occurred. The average monthly incidence for the years 1960 through 1967 is also shown for the 19-country area.

FIGURE 1. REPORTED SMALLPOX CASES BY MONTH, 1960-67 AVERAGE, 1967 AND 1968  
WEST AND CENTRAL AFRICA



Source: WHO

Table 1. Smallpox Cases Reported to World Health Organization  
West and Central Africa Area  
(Reports Received by January 30, 1969)

Country	1968												Total 1968	Total 1967	1969					
	Jan. 1-5	Feb. 6-9	March 10-13	April 14-17	May 18-22	June 23-26	July 27-31	Aug. 32-35	Sept. 36-39	Oct. 40-44	Nov. 45-48	December 49 50 51 52			January 1 2 3					
Cameroon	-	-	13	55	2	2	-	-	-	-	-	-	-	72	72	-	-	7		
Chad	-	1	-	-	-	-	4	-	-	-	-	-	-	5	86	-	-	-		
Dahomey	19	117	95	28	49	5	5	18	2	-	22	-	6	1	367	813	-	3		
Ghana	-	1	1	2	-	2	18	-	-	-	-	-	-	24	114	-	-	-		
Guinea	1	61	100	50	26	32	5	1	1	1	50	-	-	328	1,530	-	-	-		
Ivory Coast	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-		
Liberia	-	5	-	-	-	-	-	-	-	-	-	-	-	5	6	-	-	-		
Mali	21	6	-	29	-	-	1	-	1	-	-	-	-	58	164	-	-	-		
Niger	168	64	58	212	69	83	10	-	-	4	1	-	9	678	1,181	-	-	-		
Nigeria	302	496	200	229	384	65	40	28	22	51	9	2	-	1,828	4,753	-	-	-		
Sierra Leone	136	87	97	23	124	192	148	112	76	98	13	23	-	1,129	1,698	-	-	-		
Togo	66	101	54	45	22	30	50	20	109	124	36	22	25	3	733	304	11	2	1	
Upper Volta	16	-	1	10	12	-	1	18	1	41	-	..	-	100	90	-	-	-		
<b>Total</b>	<b>729</b>	<b>939</b>	<b>619</b>	<b>683</b>	<b>688</b>	<b>411</b>	<b>282</b>	<b>197</b>	<b>212</b>	<b>319</b>	<b>131</b>	<b>47</b>	<b>31</b>	<b>35</b>	<b>4</b>	<b>5,327</b>	<b>10,813</b>	<b>11</b>	<b>5</b>	<b>8</b>

- Nil

..Data not available.

In 1968 an increase in reported cases occurred during October. This reflects recent intensified active surveillance activities which presumably have increased reporting efficiencies in countries currently endemic for smallpox (Volume II, Number 5). Active case detection, in effect in these endemic areas since October, has been responsible for identifying several previously unrecognized epidemics. Immediately upon detection of an epidemic, vaccination teams are being dispatched to undertake epidemic control measures.

Provisional data for December 1968 indicate a monthly total of less than 130 smallpox cases for the total program area. This would be the lowest total number of cases on record for December.

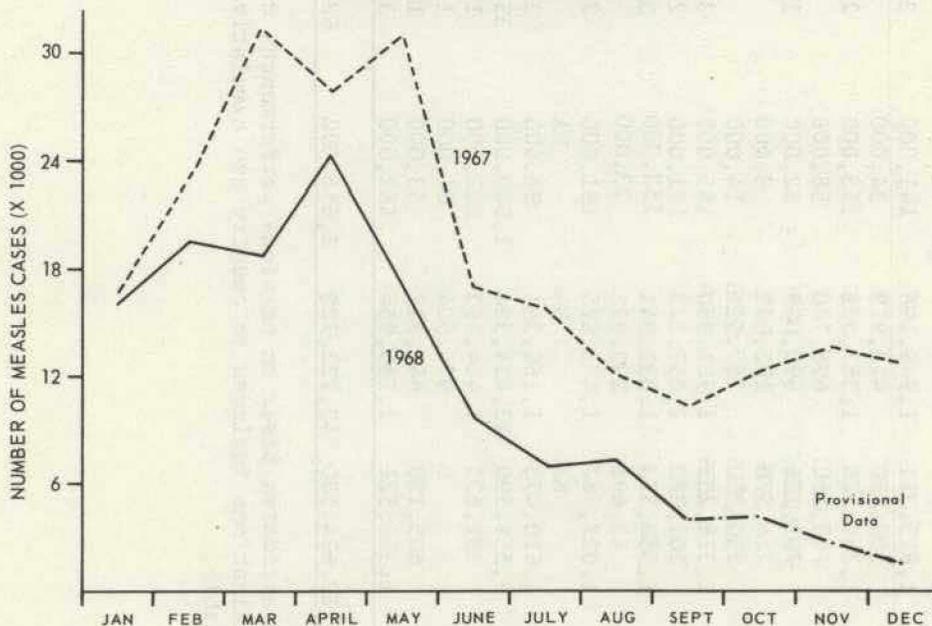
B. Smallpox Vaccination Data

The estimated cumulative total of smallpox vaccinations administered in the West and Central African area from January 1, 1967, through January 31, 1969, is 68,409,885, or 59.5 per cent of the estimated midyear 1968 population in the 19-country region. Of these vaccinations, 43,122,720 or 63.0 per cent were given in 1968 (Table 2).

C. Measles Morbidity and Vaccination Data

During 1968 a total of 140,540 measles cases were reported in the 19-countries participating in the West African Smallpox Eradication/Measles Control Program. Though the data for October - December 1968 are still incomplete, the comparison of 1968 with 1967 data continue to show a marked reduction in incidence. Figure 2 shows the seasonal pattern for the 236,631 measles cases reported during 1967 and the 1968 reported and provisional cases. (Data for the last quarter of 1968 are preliminary and will be revised upwards.)

FIGURE 2. SEASONAL DISTRIBUTION OF REPORTED MEASLES,  
WEST AND CENTRAL AFRICA



From January 1, 1967 through January 31, 1969, an estimated cumulative total of 11,011,494 measles immunizations have been administered in the West and Central African area. During 1968, 6,806,284 immunizations (or 61.8%) were performed (Table 3).

Table 2. Smallpox Vaccinations West and Central African Area  
(Provisional Data)

Country	Cumulative Total 1967	Cumulative Total 1968	January 1969*	Cumulative Total January 1967- January 1969	First Quarter 1968	Second Quarter 1968	Third Quarter 1968	Fourth Quarter 1968
Cameroon	1,815,311	1,949,196	141,000	3,905,507	416,396	647,425	267,539	617,836*
C.A.R.	380,560	413,979	34,000	828,539	146,202	122,243	52,181	93,353*
Chad	1,386,526	1,387,338	115,000	2,888,864	324,420	365,925	336,095	360,898*
Congo (B)	162,160	696,760	58,000	916,920	148,136	322,691	93,761	132,172*
Dahomey	702,136	990,099	82,000	1,774,235	275,285	308,674	149,013	257,127
Gabon	224,576	102,075	8,000	334,651	27,272	23,631	24,008	27,164*
Gambia	230,750	157,926	14,000	402,676	104,767	26,084	5,465	21,610*
Ghana	1,318,253	1,981,380	165,000	3,464,633	464,624	544,816	498,466	473,474*
Guinea	201,090	2,057,223	171,000	2,429,313	775,731	519,797	28,508	733,187
Ivory Coast	1,580,373	1,832,941	152,000	3,565,314	461,251	430,747*	532,979	407,964*
Liberia	43,691	230,875	23,000	297,566	0	54,021	91,641	85,213
Mali	1,027,787	1,455,825	161,000	2,644,612	581,025	520,229	0	354,571*
Mauritania	NA	NA	NA	NA	NA	NA	NA	NA
Niger	1,610,473	1,160,351	96,000	2,871,409 <sup>(1)</sup>	372,875	345,614	151,231	290,631
Nigeria	9,559,590	23,434,394	1,000,000	33,993,984	6,316,241	7,290,753	6,135,617	3,691,783*
Senegal	382,633	1,464,463	122,000	1,969,096	468,974	430,028	301,179	264,282*
Sierra Leone	0	974,604	81,000	1,055,604	301,693	344,246	97,255	231,410*
Togo	605,150	647,327	53,000	1,305,477	100,390	164,018	87,928*	294,991
Upper Volta	1,393,521	2,185,964	182,000	3,761,485	565,990	527,974*	546,000*	546,000*
Total	22,624,580	43,122,720	2,658,000	68,409,885 <sup>(1)</sup>	11,851,272	12,988,916	9,398,866	8,883,666

\*-Including estimates based on previous performances during 1968.

<sup>(1)</sup>-4,585 vaccinations included in country and cumulative totals, but not shown in monthly distribution totals.

NA-Not available.

Table 3. Measles Vaccinations West and Central African Area  
(Provisional Data)

Country	Cumulative Total 1967	Cumulative Total 1968	January 1969*	Cumulative Total January 1967-January 1969	First Quarter 1968	Second Quarter 1968	Third Quarter 1968	Fourth Quarter 1968
Cameroon	276,685	305,713	25,000	607,398	68,509	121,160	40,117	75,927*
C.A.R.	94,518	81,594	6,000	182,112	25,878	24,303	12,554	18,859*
Chad	202,795	198,750	16,000	417,545	46,843	61,687	46,578	43,642*
Congo (B)	0	123,488	10,000	133,488	72,604	14,377	15,088	21,419*
Dahomey	177,706	206,926	18,000	402,632	61,366	72,783	26,627	46,150
Gabon	35,506	18,242	1,000	54,758	7,775	4,188	3,243	3,036*
Gambia	55,774	36,558	3,000	95,332	22,550	5,639	2,626	5,743*
Ghana	190,514	425,730	35,000	651,244	95,593	118,123	110,329	101,685*
Guinea	13,432	278,741	30,000	322,173	106,536	69,881	0	102,324
Ivory Coast	303,547	302,600	25,000	631,147	125,150	68,465*	33,985*	75,000*
Liberia	0	47,178	3,000	50,178	0	11,184	18,932	17,062
Mali	310,774	288,001	32,000	630,775	115,686	100,042	0	72,273*
Mauritania	NA	NA	NA	NA	NA	NA	NA	NA
Niger	220,001	173,177	14,000	429,158 <sup>(1)</sup>	40,343	14,369	59,825	58,640
Nigeria	1,217,706	3,146,041	150,000	4,513,747	808,294	961,620	830,798	545,329*
Senegal	108,729	448,262	37,000	593,991	138,822	122,150	100,474	86,816*
Sierra Leone	0	150,860	16,000	166,860	50,845	53,234	10,297	36,484*
Togo	173,322	81,841	7,000	262,163	15,506	33,678	8,016*	24,641
Upper Volta	339,211	492,582	35,000	866,793	151,059	131,523*	105,000*	105,000*
Total	3,720,230	6,806,284	463,000	11,011,494 <sup>(1)</sup>	1,953,359	1,988,406	1,424,489	1,440,030

\*- Including estimates based on previous performances during 1968

<sup>(1)</sup>-21,980 vaccinations included in country and cumulative totals, but not shown in monthly distribution totals.

NA-Not available.

## II. ERADICATION NOTES

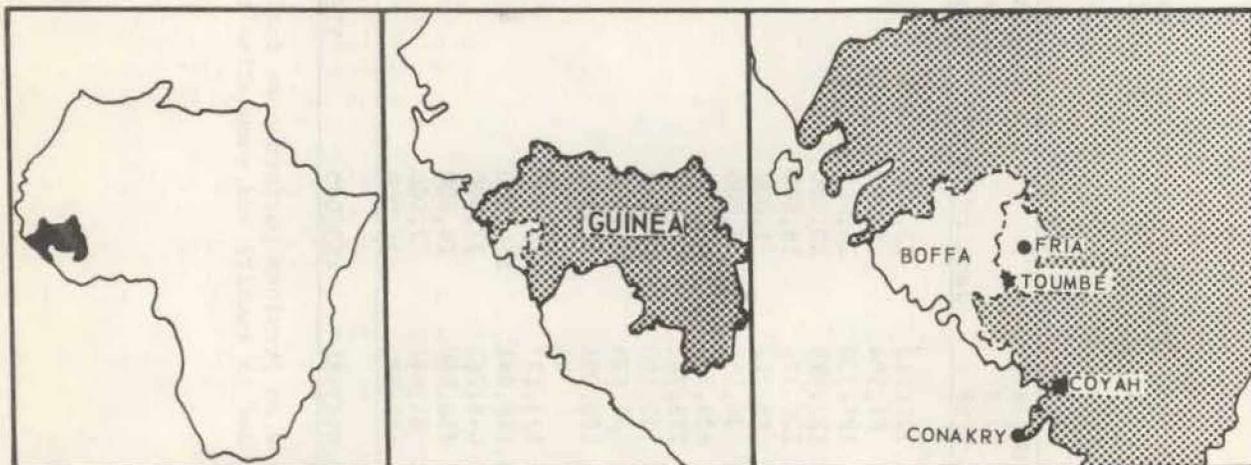
### A. Smallpox Epidemic in Toumbé, an Isolated Village in Guinea

On June 18, 1968, smallpox cases in the village of Toumbé, Region of Fria, Guinea, were reported by the Chef du Secteur to the Service National des Grandes Endemies (SNGE) in Conakry. Two days later, on June 20, the SNGE Chief of the Region of Fria and the U.S. Medical Officer for the Guinea Smallpox/Measles Program investigated the epidemic in Toumbé and submitted the following report. They detected no smallpox elsewhere in the Toumbé area at that time.

#### Background

Toumbé is an isolated village located in Tormelin, the southernmost arrondissement of Fria, about 60 miles northeast of Conakry. It lies near the border of Boffa, the region west of Fria. Prior to the epidemic outbreak, Toumbé had reported no cases of smallpox for forty years. Since June 1967, Boffa had reported smallpox cases almost every month, excepting November and December 1967, and February 1968.

FIGURE 3. SMALLPOX OUTBREAK IN TOUMBÉ, REGION OF FRIA, GUINEA



The population of Toumbé is 303 persons according to a May 1967 official census which includes residents of five satellite villages lying within a 6-mile radius of Toumbé. The village of Toumbé itself had a population of 83 inhabitants at the time of the investigation. The population of the arrondissement is 5,197 inhabitants, and there are 33,530 in the whole region.

The SNGE performed approximately 15,000 smallpox vaccinations in the Region of Fria from January 1965-December 1967.

Toumbé is exclusively a farming village, and during the early rainy season, in May and June, the villagers spend most of their time in nearby fields. During the month prior to the smallpox outbreak, none of the villagers had left Toumbé. They had experienced no recent contact with the satellite villagers. They had received only two visitors in the village, one of whom became ill with smallpox shortly after arriving in Toumbé.

#### The Epidemic

On May 13, a three-year-old Toumbé boy who, for the previous year, had resided in Demoukala, a village fifteen kilometers distant in the Region of Boffa, returned to his family in Toumbé. He was accompanied by a Demoukala villager who appeared healthy and departed for home the following day.

A few days later, the child became ill with fever, developed a papular rash by May 20, and died ten days later. Over the next month, 19 cases of smallpox, including two more deaths, occurred among the Toumbé villagers.

The SNGE Chef du Secteur visited Toumbé on June 3, verified the epidemic as smallpox, and vaccinated all previously unvaccinated inhabitants of the village. He subsequently reported the epidemic to the SNGE in Conakry and returned to Toumbé on June 20 as part of the follow-up investigation team.

#### Vaccinations and Epidemic Control Activities

On June 20, the follow-up investigation team vaccinated the entire Toumbé village population. Three days later, the Smallpox/Measles Program campaign began regular activities in the Region of Fria by vaccinating the arrondissement of Tormelin (performing 4,175 vaccinations). Throughout Fria, a total of 30,770 vaccinations were performed as a result of regular and epidemic control activities.

In addition, assessment and follow-up teams visited every village and city along the main road between the town of Fria (Figure 4) in the north and Coyah in the south but observed no evidence of recent smallpox occurring in these areas.

Teams also went into Boffa to investigate the areas implicated as a source for the Toumbé outbreak. (Just prior to the Fria campaign, the regular vaccination team had vaccinated the Region of Boffa, achieving a vaccination coverage of over 80 per cent of the population.)

#### Epidemiological Investigation

The 83 Toumbé residents consisted of six families living in eight dwellings grouped around a mosque situated at the center of the village (Figure 4). The inhabitants lived in close proximity and mixed frequently with no regard to sex or age group distinction. During the epidemic, at least one case of smallpox occurred in each family unit with the family of the three-year-old boy who initially brought smallpox to Toumbé (the index case) having a total of six cases. Figure 5 shows the epidemic curve. No cases occurred after June 19. Three of the individuals contracting smallpox claimed previous vaccination, but none within the past five years. One of the three did not show a visible primary vaccination scar.

FIGURE 4. VILLAGE OF TOUMBÉ, GUINEA

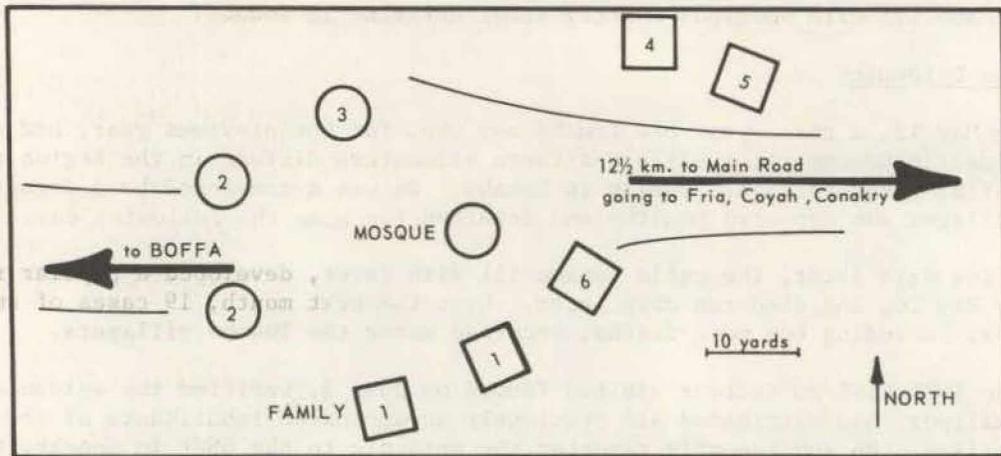
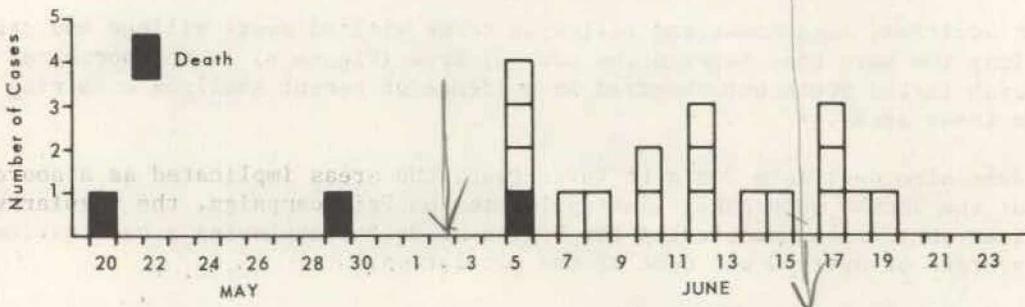


FIGURE 5. SMALLPOX CASES BY ONSET OF LESIONS, TOUMBÉ, GUINEA



Age and sex data on the 20 smallpox cases are presented in Table 4. Nine cases, including the three deaths which resulted during the epidemic, were in children less than 4 years of age. The overall attack rate (per 100 population) was 24.1. Sixty-one per cent of the susceptible children under age

Table 4. Age and Sex Distribution, Attack Rate\* and Secondary Attack Rate\* for Village of Toumbé, Guinea

Age	Male	Female	Total Cases	Total Population	Attack Rate	Secondary Attack Rate among Susceptible Population
<1	1(1)	2(1)	3	5	60.0	60.0
1-4	5(1)	1	6	9	66.7	62.5
5-14	3	3	6	26	23.1	27.3
15-44	4	1	5	32	15.6	55.6
45+	0	0	0	10	-	-
Unk.	0	0	0	1	-	-
Total	13	7	20	83	24.1	43.2

\* Per 100 population.  
( ) Deaths

5 were infected upon secondary transmission of the disease, and the overall secondary attack rate was 43.2 per 100 population (Table 4). The epidemic did not progress past the second generation.

A scar survey was conducted among the 82 Toumbé inhabitants. Forty villagers gave a history of previous vaccination, none earlier than five years previous. Thirty-five of them were examined, and thirty-one (88.6%) showed healed vaccination scars. Only two individuals in this group had contracted smallpox during the epidemic.

The remainder of the Toumbé population, or 42 persons, did not claim previous vaccination. Seventeen cases of smallpox had occurred among these individuals. The boy who had the index case of smallpox had never been vaccinated.

#### Discussion

In Toumbé, the transmissibility of smallpox was evidently greatly modified by the vaccinations given by the Chef du Secteur on June 8. The twelve cases which developed after his departure were probably in individuals who contracted smallpox prior to being vaccinated. The follow-up investigation team who visited Toumbé on June 20 and vaccinated the total population observed several villagers with fever, none with severe headache or backache. These villagers could have been infected with smallpox at that time though no subsequent visit was made to Toumbé to verify this conjecture.

#### Conclusion

Twenty cases of smallpox including three deaths occurred in an isolated village in Guinea which claimed to be free from smallpox for 40 years. Almost 25 per cent of the village population and 43 per cent of all the susceptible villagers developed smallpox within one month. Vaccination teams were able to contain the epidemic to the village itself, and assessment teams detected

no recent spread to neighboring areas. The source of the epidemic was traced to an adjacent region known to be endemic for smallpox prior to the present outbreak.

(Reported by B. Alecaut, M.D., Directeur, Service National des Grandes Endemies, Guinea; Joel G. Breman, M.D., Guinea Smallpox/Measles Program; and Smallpox Eradication Program, NCDC.)

## B. Smallpox in a Well-Vaccinated Area of Niger

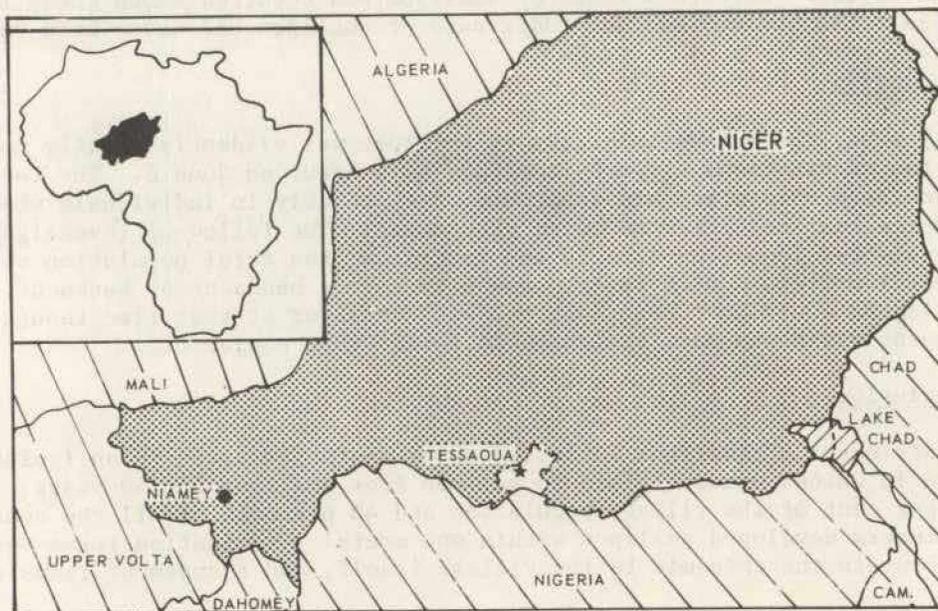
### Introduction

On June 22 and July 3, the Niger Ministry of Health received telegraphic reports of smallpox cases occurring in Tessaoua, an arrondissement on the south-central frontier. Following each report, the Smallpox Eradication/Measles Control Program dispatched immediate inquiries to Tessaoua, an arrondissement which had been well-vaccinated by SMP teams in November and December 1967, and, receiving no response by July 11, sent an investigation team to the area. The team subsequently located all reported cases in the small village of Dagouégé (population 339). They proceeded with investigation activities and traced the source of the epidemic to a small Nigerian village near the Niger border, with an intermediate passage to the village of Dambago, in another area of Tessaoua. The SMP Operations Officer and his host-country counterpart submitted the following epidemic investigation report.

### Background

The arrondissement of Tessaoua (population: 175,682) is part of the most densely populated section of Niger, the narrow strip of semi-arid land which stretches along the southern border from Niamey in the west to Lake Chad in the east. Because of the vast desert regions of the north, most of Niger's 3.5 million inhabitants are concentrated in this area of the country where most of the principal food crops are grown (Figure 6).

FIGURE 6. SMALLPOX OUTBREAK, ARRONCHSSEMENT OF TESSAOUA, NIGER



Tessaoua has a common 100-kilometer-long border with Nigeria. Most of the inhabitants are sedentary farmers, and ground nuts is the main crop. The principal ethnic group is the Hausa, who also inhabit the northern part of neighboring Nigeria, and nomadic cattle-raising groups comprise the majority of the remaining population. In Tessaoua, as in other border areas, population groups from both sides of the border frequently mix for commercial as well as social purposes.

In November and December 1967, during the annual ground nut harvest, three SMP vaccination teams vaccinated the arrondissement of Tessaoua (Table 5). In addition to the permanent residents of Tessaoua, the teams vaccinated many individuals from outside the arrondissement who were in Tessaoua at the time to participate in the ground nut harvest. Therefore, more vaccinations were given during the campaign than the number of inhabitants, based on population estimates, in Tessaoua.

Immediately following the campaign, the SMP team in the Canton of Gangara conducted a "take" assessment survey of vaccinations, revealing a "take" rate of 92.3 per cent. No further assessment of the Tessaoua campaign was conducted, though all teams generally felt that populations throughout the area had been receptive to vaccination.

Table 5. SMP Campaign Vaccinations for Smallpox, Tessaoua, November and December, 1967

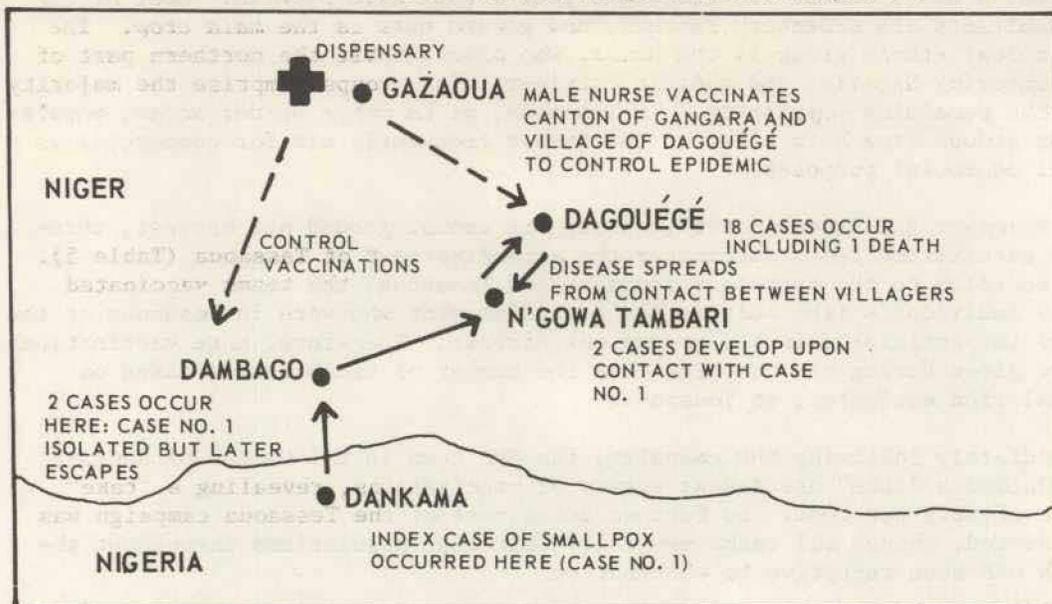
Area	Estimated Population	Number of Vaccinations
Tessaoua Arrondissement	175,682	221,246
Dagouégé Village	339	296
Korgom Canton	22,178	29,296
Gangara Canton	31,067	28,869

#### The Epidemic

In early May 1968, a 35-year-old male villager from Dagouégé who had never been vaccinated against smallpox went to Dankama, Nigeria, (5 kilometers from the Niger border) to attend a family wedding feast. In returning home a few days later, he became ill and stopped in the Niger village of Dambago, Canton of Gangara (Tessaoua), where he contacted other family members from Gangara who were visiting Dambago to attend a baptism. During his stay in the village, he resided in the same compound with two younger relatives who had never been vaccinated against smallpox and who subsequently became ill with the disease. A male nurse who had come to Dambago from Gazaoua, the principal town in the area, recognized the Dagouégé villager as having smallpox, promptly put him into isolation, and, later, vaccinated 2,773 people in the Canton of Gangara. The two young relatives of the man having the "index" case of smallpox were also put into isolation, and no further cases developed in the Gangara area.

However, after staying only 20 days in isolation, the 35-year-old Dagouegean villager fled Dambago to return home. En route, he stopped to visit other relatives in the village of N'Gowa Tambari, just south of his native village, where he infected two of his nephews who were previously unvaccinated against smallpox. Because of the proximity of the two villages, relatives from Dagouégé later came to visit the two sick nephews in N'Gowa Tambari and, subsequently, spread the disease to Dagouégé.

FIGURE 7. MAP OF DISEASE SPREAD, TESSAOUA OUTBREAK, NIGER



Vaccinations and Epidemic Control Activities

Including the vaccinations performed by the male nurse from Gazaoua, more than 3,000 control vaccinations were performed in Tessaoua during the outbreak. The SMP investigation team made a quick survey of take rates two weeks after the control vaccinations and reported apparently good results; however, these data are not available.

Isolation of cases (with the exception of the index case) was also successful. No further spread of smallpox resulted from the two young children who remained well-isolated in Dambago for 40 days.

The SMP team, in terminating investigation of the Tessaoua outbreak, left 2,500 doses of smallpox vaccine for future use in the arrondissement.

Epidemic Investigation

Table 6 presents age and sex distribution of 18 cases of smallpox which developed in Dagouégé villagers after the initial spread of the disease from the two ill nephews in N'Gowa Tambari. The SMP team investigated these cases on July 13.

Table 6. Age and Sex Distribution of Smallpox Cases in Dagouégé

Age	Male	Female	Total
<1	0	0	0
1-4	2	5	7
5-14	4	2	6
15-44	4	1	5
45+	0	0	0
<b>Total</b>	<b>10</b>	<b>8</b>	<b>18</b>

Five cases of smallpox were in individuals who contracted smallpox while visiting the two smallpox patients in N'Gowa Tambari. All of these persons lived in the same compound (compound 1) and had never been vaccinated. They experienced severe illness, probably classical variola major.

The epidemic then spread to members of a neighboring compound (compound 2) where a total of ten individuals were subsequently infected. Three of these had never been vaccinated, and one of the three appeared extremely weak and desiccated at the time of the investigation (his death seemed imminent).

Six had developed first symptoms of the disease three days after being vaccinated by the male nurse from Gazaoua during his initial visit to Dagouégé (around June 22) to perform control vaccinations. The remaining individual from compound 2, who missed the first control vaccination session, developed symptoms two days following his vaccination during the male nurse's second visit to Dagouégé on July 2.

One individual from another compound (compound 3) developed first symptoms of smallpox three days after his vaccination during the initial control vaccination session. In compound 4, a villager (who was absent from Dagouégé both in November 1967, during the SMP vaccination session in the village, and in June, during the first control vaccination session) developed symptoms three days after vaccination on July 2.

The eight villagers who contracted smallpox and were vaccinated during the epidemic experienced mild cases of the illness.

One smallpox case was in a 3-year-old female who died prior to the investigations of July 13.

#### Discussion

A scar survey performed in Dagouégé on July 13 indicated that an inadequate percentage of the population had been vaccinated during the SMP vaccination campaign of November 1967. Because of frequent traveling in the area, poor vaccination coverage of the Dagouégé population can be attributed to the fact that many of the villagers were absent during the vaccination session.

#### Conclusion

Smallpox outbreaks along the Nigeria-Niger frontier can be expected until both sides are satisfactorily covered by vaccination from Lake Chad in the east to Dahomey in the west.

The Niger SMP, having completed mass vaccination in western Niger prior to the Tessaoua outbreak, established maintenance phase operations during the investigation trip to the area, and surveillance activities are already underway at dispensaries and key road crossings on the border.

(Reported by Leon Tchelle, M.D., Directeur du Service National d'Hygiène et de la Médecine Mobile, Niger; I. Alzouma, National Counterpart, Smallpox/Measles Program, Niger; A.R. Masso, Niger Smallpox/Measles Program; and Smallpox Eradication Program, NCDC.)

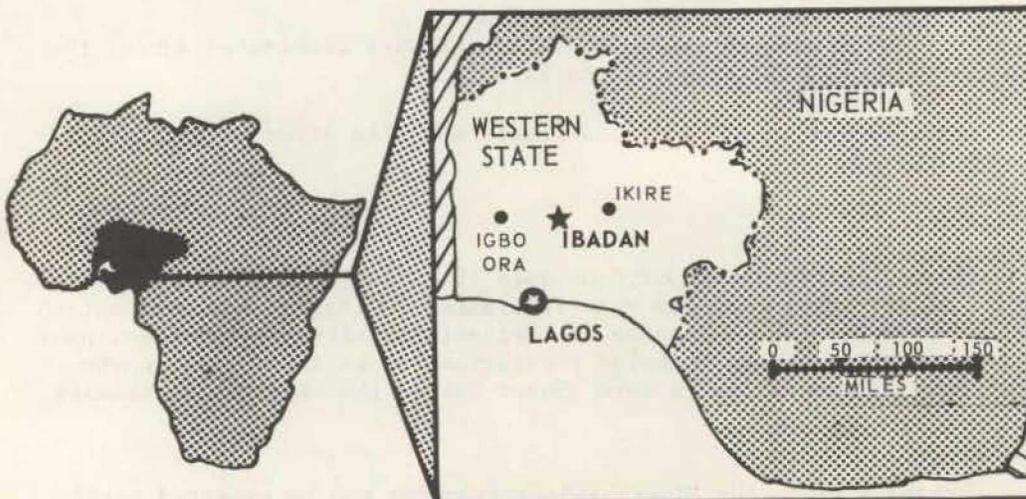
C. Measles Epidemiology in Western State, Nigeria

Introduction

The following report is based primarily on data collected at four urban hospitals in Ibadan, Western State, Nigeria, from January 1967 through August 1968. Measles cases from these hospitals will be compared to those observed at two rural health centers, Igbo Ora and Ikire. Additional data on state-wide incidence of reported measles cases since 1961 is also presented. The intent of the study is to assess the effect of measles vaccinations efforts in the Western State and to determine, if possible, whether there is any basic difference between urban and rural areas as to measles incidence and age distribution.

The estimated population of Western State Nigeria is 10.5 million inhabitants. It is the most highly urbanized area of Nigeria with twelve of its cities having populations over 100,000. Eighty per cent of the total population of the State is contained in towns of over 10,000 inhabitants.

FIGURE 8. WESTERN STATE NIGERIA



The largest population center is the city of Ibadan which includes approximately 750,000 inhabitants. Ibadan, a center of trade, education and administration, is also the largest indigenous city in sub-Saharan Africa. It is located 89 miles northwest of Lagos, the federal capital of Nigeria.

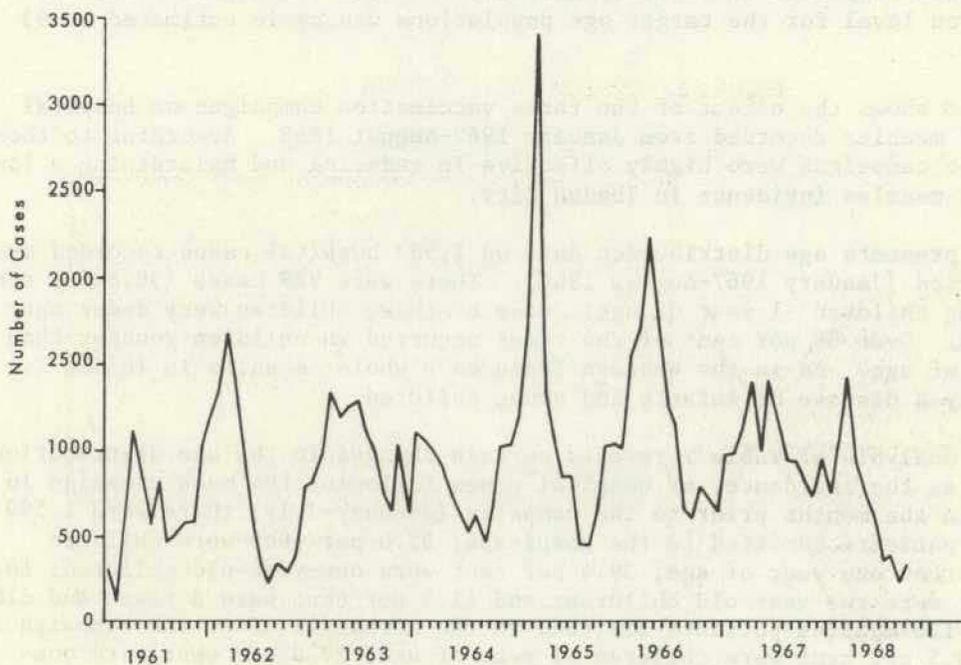
The town of Ikire, located 25 miles northeast of Ibadan, contains approximately 55,000 inhabitants. It is contiguous with another large-size town and lies on a heavily traveled route in a district with a population density of 889 persons per square mile. The rural health center at Ikire serves both the town and surrounding villages.

The town of Igbo Ora, located 65 miles west of Ibadan, has a population of 35,000 inhabitants. As contrasted to Ikire, it is situated on a lightly traveled route with no major-size towns nearby, in a district of much lesser population density, with only 128 persons per square mile. Most Igbo Ora townsmen spend a considerable portion of their time on outlying farms. During the planting season, over half the population is living outside the town, though on weekends many inhabitants return to Igbo Ora.

#### Measles Epidemiology in the Western State

Figure 9 shows the annual overview of reported measles cases in the Western State from 1961-1968. As in most areas of West Africa, reported cases are a fraction of cases thought to occur.

**FIGURE 9. REPORTED MEASLES CASES BY MONTH, WESTERN NIGERIA  
1961 - 1968**



Measles incidence in the Western State generally reaches a peak in the months February, March and April, during the mid-dry season. It often shows an increase during November or December, immediately after the end of the rainy season.

During 1967 measles immunizations were launched throughout the Western State as part of the Nigerian Smallpox Eradication and Measles Control Program. Through August 1968, a total of 910,899 vaccinations had been administered to children ages 6 months-3 years. This represented a vaccination coverage of approximately 92 per cent of the target age population.

Data on age incidence of measles cases in the Western State were not available prior to May 1967, when the surveillance system first went into effect. Analysis was made of 10,437 measles cases recorded during the period May 1967-July 1968.

Seventy-nine per cent, or 8,257 cases, were in children younger than three years of age. Children under two years of age accounted for over 64 per cent of the total cases. There were 2,243 cases (21.4 per cent) occurring in children younger than one year of age. These data illustrate that measles in the Western State occurs primarily in infants and very young children.

#### Ibadan

During the "kick-off" vaccination campaign for the Western State, conducted in Ibadan in July 1967, over 73,000 children ages 6 months-3 years were vaccinated against measles. A follow-up assessment involving 1,025 children in this age group revealed 953 children vaccinated during the 10-day campaign, representing a 93 per cent vaccination coverage of the target age group population. In addition to the mass campaign, "maintenance" campaigns were conducted in February and July of 1968. In August 1968, the protection level for the target age populations was again estimated at 93 per cent.

Figure 10 shows the effect of the three vaccination campaigns on hospital cases of measles recorded from January 1967-August 1968. According to these data, the campaigns were highly effective in reducing and maintaining a low level of measles incidence in Ibadan City.

Table 7 presents age distribution data on 1,982 hospital cases recorded over this period (January 1967-August 1968). There were 729 cases (36.8 per cent) involving children <1 year of age: none of these children were under age 4 months. Over 88 per cent of the cases occurred in children younger than 3 years of age. As in the Western State as a whole, measles in Ibadan is primarily a disease of infants and young children.

Further analysis of Table 7 reveals certain changes in the age distribution, as well as the incidence, of hospital cases following the mass campaign in 1967. In the months prior to the campaign (January-July) there were 1,599 measles patients admitted to the hospitals; 35.0 per cent were children younger than one year of age; 39.4 per cent were one-year-old children; 14.1 per cent were two-year-old children; and 11.5 per cent were 3 years and older. Of 126 measles patients admitted to the hospitals after the campaign in 1967, 40.5 per cent were children <1 year of age; 27.8 per cent were one-year-olds; 4.4 per cent were two-year-olds; and 10.3 per cent were 3 years and older.

FIGURE 10. HOSPITALIZED MEASLES CASES, IBADAN (WESTERN STATE) NIGERIA

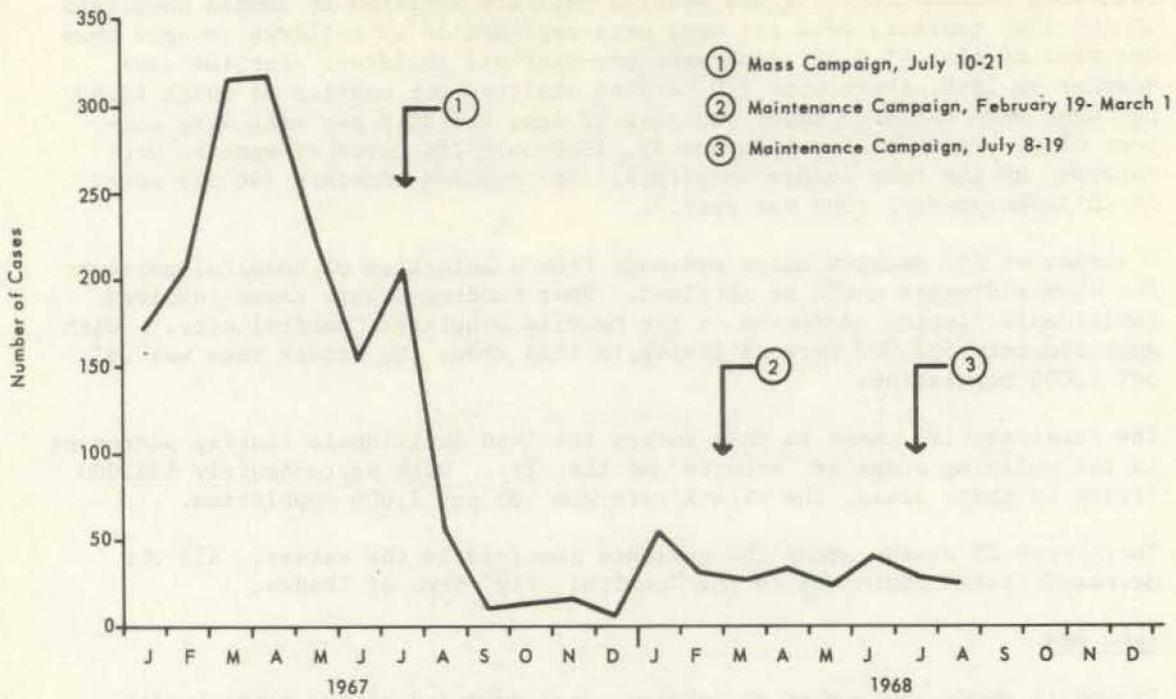


Table 7. Measles Cases, Ibadan City  
1967 and 1968

Month	Age				Total
	<1 yr.	1	2	3+	
January 1967	65	68	20	20	173
February	62	91	32	22	207
March	82	131	47	56	316
April	111	119	58	29	317
May	87	77	33	29	226
June	80	56	8	10	154
July	72	88	28	18	206
August	25	24	23	9	56
September	8	1	1	0	10
October	8	3	0	2	13
November	7	5	2	2	16
December	3	2	1	0	6
January 1968	32	14	3	5	54
February	8	13	2	7	30
March	8	7	7	4	26
April	14	14	3	2	33
May	12	4	4	2	22
June	18	13	3	4	38
July	16	7	3	1	27
August	11	11	1	1	24
<b>Total</b>	<b>729</b>	<b>748</b>	<b>282</b>	<b>223</b>	<b>1,982</b>

In comparing the age distribution of hospital cases for the first quarter of 1968 with the corresponding 1967 quarter, similar results are observed following vaccination. Of 696 measles patients admitted to Ibadan hospitals in the 1967 quarter, 30.0 per cent were represented by children younger than one year of age; 41.7 per cent were one-year-old children. For the same quarter in 1968, there were 110 persons admitted for measles of which 43.6 per cent were children under one year of age, and 30.9 per cent were one-year olds. From January 1-August 31, 1968 only 254 cases of measles were recorded by the four Ibadan hospitals. One hundred-nineteen (46.9%) were in children younger than one year.

A survey of 592 measles cases was made from a selection of hospital patients for whom addresses could be obtained. Four hundred-eighty cases involved individuals listing addresses in the heavily populated "central city." With approximately 552,000 persons living in this area, the attack rate was .87 per 1,000 population.

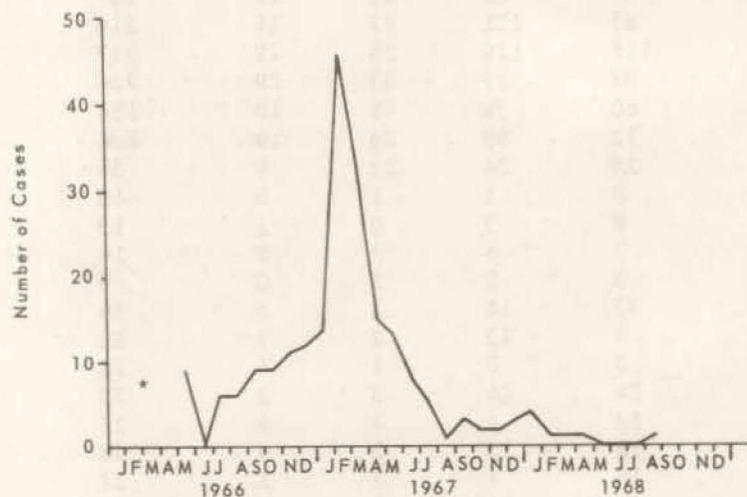
The remaining 112 cases in this survey involved individuals listing addresses in the outlying areas or "suburbs" of the city. With approximately 132,000 living in these areas, the attack rate was .85 per 1,000 population.

There were 25 deaths among the patients involved in the survey. All the deceased listed addresses in the "central city" area of Ibadan.

#### Igbo Ora

Figure 11 shows the number of measles cases recorded at the rural health center at Igbo Ora from May 1966-August 1968. These data include 62 cases recorded during the last eight months of 1966, 143 cases for the 1967 year and 8 cases from January-August 1968.

**FIGURE 11. REPORTED MEASLES CASES  
IGBO ORA, WESTERN STATE, NIGERIA**



\* Data not available prior to May

The number of cases increased in late 1966, at the beginning of the dry season, and reached a peak in February 1967, at mid-dry season. Thereafter, the number of measles cases declined steadily, considerably before the mass vaccination campaign reached Igbo Ora in April 1968 (when 24,000 measles immunizations were administered to children ages 6 months-3 years).

During a pilot vaccination project conducted in Igbo Ora in February 1967, approximately 1,500 Igbo Ora children, the majority of which resided in the town, were immunized against measles. A neighboring town and some villages were subsequently vaccinated as part of the pilot project. The reduced number of measles cases recorded by the rural health center after February 1967, is an indication that these pilot vaccinations, combined with natural measles, probably helped reduce the pool of susceptible individuals in the area prior to the regular campaign.

The age distribution for Igbo Ora measles cases is incomplete, however, Table 8 presents the available data for 1966 and 1967.

Table 8. Measles Cases by Age Group, Igbo Ora, Western State, Nigeria 1966 and 1967

Age Group	1966	1967
<1	0	0
1	2	9
2	20	35
3+	26	15
<b>Total</b>	<b>48</b>	<b>59</b>

Ninety per cent of the total cases for 1966 and 1967, occurred in children age two years of age and older. Thirty-eight per cent of the cases were in children three years of age or older. The age distribution of cases in Igbo Ora differs considerably from the Ibadan findings (where the majority of cases occurred in children younger than two years of age).

#### Ikire

Table 9 presents the age distribution of measles cases recorded at the Ikire rural health center during 1967, and from January-September 1968. During 1967, eight out of 18 cases occurred in children younger than one year of age; also, seven of the 18 occurred in children three years of age. Table 9 also shows the month of report.

Table 9. Reported Measles Cases, Ikire, Western State, Nigeria 1967 and 1968

#### A. Age Group

Age Group	1967	1968*
<1	8	8
1	3	3
2	0	8
3+	7	5
<b>Total</b>	<b>18</b>	<b>24</b>

Table 9. (Continued)

## B. Month of Report

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1967	0	0	6	6	2	1	0	0	0	1	0	2
1968*	1	4	3	9	3	1	2	0	1			

## \* Through September

In 1968, the Ikire Health Center reported 24 measles cases. Eight cases occurred in children younger than one year of age. Five cases were in children three years of age or older.

The mass measles immunization campaign was conducted in Ikire in April 1968. No prior measles immunizations had been given in the community. Subsequent to the immunization campaign, seven cases were reported to the health center: five of these occurred in children younger than one year of age.

Discussion

In the Western State there is little farming activity during the dry season, and the people return to their villages or towns. Various festivals are celebrated, and there is frequent mixing of different population groups. Particularly then, the African mother's practice of carrying her young child about on her back creates good circumstances for the spread of droplet infection among young children susceptible to measles. During the dry season in the Western State, measles incidence has often reached epidemic proportions.

A decline in measles incidence in the Western State generally corresponds with the coming of the rainy season. This is the time when most of the people return to their farms in the more sparsely populated, rural areas of the State. This may indicate that measles in the Western State fluctuates seasonally only in the sense that it occurs more frequently during those times of the year when the possibility of transmission is increased: when the majority of the population is grouped in centers, such as, villages, towns and cities rather than located in isolated farm groups.

Analysis of the data on measles cases recorded in Ibadan, Ikire, and Igbo Ora, reveals at least three patterns of age incidence occurring in the State: urban, intermediate and rural. The effect of mass measles vaccinations is reflected within these patterns.

In the urban pattern, as demonstrated by the Ibadan data, approximately 87 per cent of the measles cases recorded prior to the mass campaign occurred in children younger than three years of age (and older than 4 months); over one-third of the cases were in infants less than 12 months old. Mass vaccination efforts significantly reduced the measles incidence in Ibadan, but as expected there was an increase in the percentage of cases in the less than one year age group. Six months later, the measles incidence was again increasing.

Subsequent maintenance immunization campaigns were effective in reducing and maintaining at low levels the number of reported cases occurring among Ibadan children. During this time, the age distribution of cases showed an even greater concentration in the less than one year age group.

In the rural pattern of measles in the Western State, demonstrated by the Igbo Ora experience, the age distribution of measles cases differs significantly from the urban experience. Before vaccination, the majority of cases (51 per cent) occurred in children two years of age (24-35 months), and a large portion (38 per cent) occurred in children ages 3 years or older. Age distribution of cases recorded in Igbo Ora in 1968 was not available.

The intermediate pattern, as reflected in the Ikire data, shows characteristics of rural and urban age incidence. Prior to vaccination efforts in the area, measles occurred most frequently in infants under one year of age and in children three years of age and older. Following the mass vaccination campaign in April 1968, Ikire recorded seven cases of measles of which five were in children under one year of age.

#### Conclusion

Children living in an urban or semi-urban environment are generally in contact with measles at an earlier age than children from the rural areas. However, the factors contributing to this experience are not clear. The crowding in the cities with the increased opportunity for rapid spread of droplet infection among children is a probable explanation for the urban situation. This probability of infection is reduced in the less crowded rural situation where children may miss exposure to measles until an older age.

In the urban areas, such as Ibadan, and in the semi-urban areas, such as Ikire, maintenance vaccinations are essential every 6 months to keep the disease under effective control. In a rural area, such as Igbo Ora, maintenance vaccination could probably be performed at intervals of two years without the disease rising to epidemic proportions.

(Reported by E. Ademola Smith, M.D., Director, Nigeria Smallpox/Measles Programme for Permanent Secretary, Federal Ministry of Health; Joseph I. A. Adetosoye, M.D., Ministry of Health, Western State, Nigeria; Margaret E. Grigsby, M.D., (West) Nigeria Smallpox/Measles Program, 1966-1968; and Smallpox Eradication Program, NCDC.)

#### D. Measles Epidemic near Salo, Central African Republic

##### Introduction

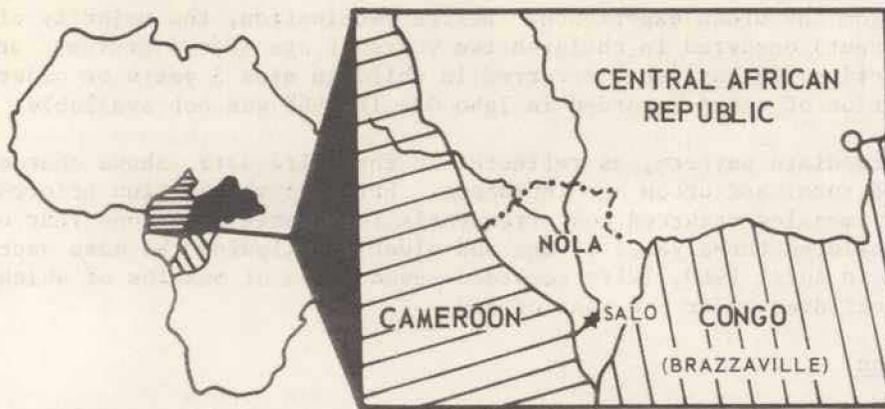
This report describes a measles epidemic in which the age distribution of cases is quite unlike that which has occurred in other African countries, though the age specific fatality rates are generally characteristic.

The epidemic was confined to the "Groupement Kouapouli", a group of seven small villages in the extreme southwest tip of the Central African Republic near the borders of Cameroon and Congo-Brazzaville (Figure 12).

##### Background

Kouapouli is part of the subprefecture of Nola (population: 8,400) which, with an average of 1.1 persons per square kilometer, is one of the most sparsely populated areas in C.A.R. The Nola area is characterized by rain forest with occasional intrusions of wooded savanna.

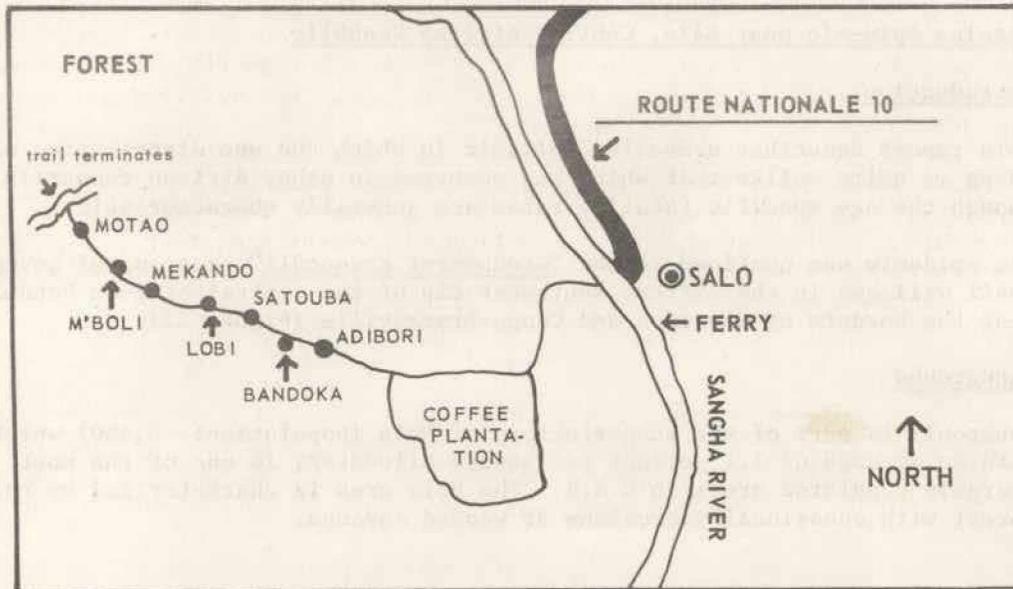
FIGURE 12. MEASLES EPIDEMIC, KOUAPOULI, C.A.R.



The village of Salo (population: 1,000) is situated 10.1 kilometers from the closest of the Kouapouli villages and a coffee plantation is located equally distant between the two. At Salo, the Route Nationale 10 terminates at the Sangha River. Coffee beans are shipped south by barge to Brazzaville; returning barge traffic includes import products, trucked north by the Route Nationale 10, for much of southwestern C.A.R. (Figure 13).

The Kouapouli villagers generally have little contact with the Salo inhabitants or with the Sangha River traffic. Many of the villagers sell food to workers on the coffee plantation, where they sometimes take temporary jobs during the harvest season. On occasion, they trade with some Pygmy villagers from the forest nearby. Otherwise, they gain a traditional livelihood of food gathering and hunting.

FIGURE 13. DETAILED MAP OF "GROUPEMENT KOUAPOULI," C.A.R.



## The Epidemic

Word that a major measles epidemic was currently underway in Kouapouli was first received by the C.A.R. Service des Grandes Endemies (Endemic Disease Service) on October 17, 1967. On October 18, an investigation in Salo revealed many sick children. The next day in Adibori, 50 children from the Kouapouli area were diagnosed as having measles. Also the same day, 40 more cases of measles were diagnosed in the nearby village of Lobi. It was learned that the first measles case in the area occurred in late August in the village of M'Boli. During September, the number of measles cases had increased slowly throughout the seven villages before reaching epidemic proportions in October.

## Vaccinations and Epidemic Control Activities

Plans for organizing a special measles vaccination program for the entire subprefecture of Nola were initiated immediately. Epidemic control vaccinations began on October 24. By October 29, a total of 2,248 vaccinations had been given throughout the Nola subprefecture. In Salo, the target population included all possible susceptibles between the ages of six months and ten years. Of the 442 children from the Kouapouli area in this group, 307 of them had already contracted measles. One hundred-five of the remaining 135 susceptibles were then vaccinated.

## Epidemiological Investigation

On November 11, a house-by-house investigation was made of 150 families with children in the Kouapouli area. Practically all children up to age 15 years were seen. Tables 1 and 2 present data supplied by parents of the children and by an African nurse from Adibori. Age data are based primarily on birth certificates and on other information produced by the villagers and by the nurse. One measles case is excluded from all tables; it involved a 25-year-old female.

A total of 510 children were visited (Table 10). Among these, 318 children (62.4 per cent) had contracted measles: this includes two children from the Pygmy village (population: 32) who became infected after measles had already appeared among the Kouapouli children. Of the 318 measles cases, 58 (18.2 per cent) occurred in children ages 7-15 years. Of a population of 20 children under six months of age, two children were infected. The age distribution of these cases is quite different than that usually observed in West and Central Africa. Similar attack rates were observed for males and females.

A total of 21 deaths occurred among the infected children. All of the deceased were children younger than six years of age. Two children, one of whom died, were infected in the less than six-months age group. The overall case fatality ratio was 6.6 per cent.

Table 10. Kouapouli Measles Epidemic, General Investigation

Age	Children Seen			Measles Cases			Percent Cases by Age	Cum. %	Rate/100 Children		
	M	F	Total	M	F	Total			M	F	Total
<6 mo.	11	9	20	0	2	2	0.6	0.6	-	22.2	10.0
6 mo.-1 yr.	10	4	14	6	3	9	2.8	3.5	60.0	75.0	64.3
1 yr.	20	12	32	18	10	28	8.8	12.3	90.0	83.3	87.5
2	28	29	57	27	24	51	16.0	28.3	96.4	82.8	89.5
3	24	29	53	21	24	45	14.2	42.5	87.5	82.8	84.9
4	30	32	62	27	26	53	16.7	59.1	90.0	81.3	85.5
5	21	24	45	18	18	36	11.3	70.4	85.7	75.0	80.0
6	23	21	44	18	18	36	11.3	81.8	78.3	85.7	81.8
7	18	22	40	11	11	22	6.9	88.7	61.1	50.0	55.0
8	13	10	23	3	3	6	1.9	90.6	23.1	30.0	26.1
9	11	16	27	5	7	12	3.8	94.3	45.5	43.8	44.4
10	15	10	25	3	4	7	2.2	96.5	20.0	40.0	28.0
11	8	6	14	3	1	4	1.3	97.8	37.5	16.7	28.6
12	11	8	19	3	0	3	0.9	98.7	27.3	-	15.8
13	4	6	10	0	1	1	0.3	99.1	-	16.7	10.0
14	4	10	14	0	1	1	0.3	99.4	-	10.0	7.1
15	4	7	11	0	2	2	0.6	100.0	-	28.6	18.2
<b>Total</b>	<b>255</b>	<b>255</b>	<b>510</b>	<b>163</b>	<b>155</b>	<b>318</b>			<b>63.9</b>	<b>60.8</b>	<b>62.4</b>

Table 11 presents measles case rates for the seven villages. For children ages 0-15 years, all rates are consistently high, though there is wide variation from village to village. These rates vary from 44 cases per 100 children in M'Boli, to 93 cases per 100 children in Mekanda. By sex they vary from 51 cases per 100 males in M'Boli to 100 per 100 males in Mekanda.

Table 11. Measles Case Rates by Village

Village	Children Seen			Measles Cases			Attack Rate/100 (Total)	Total Village Population	Rate/100 Population
	M	F	T	M	F	T			
Adebori	65	55	120	44	31	75	62.5	286	26.2
Pygmy Village	3	3	6	2	0	2	33.3	32	6.3
Bandoka	56	66	122	31	37	68	55.7	280	24.3
Satouba	19	17	36	13	12	25	69.4	96	26.0
Lobi	31	30	61	18	19	37	60.7	151	24.5
M'Boli	33	28	61	17	10	27	44.3	169	16.0
Mekanda	19	22	41	19	19	38	92.7	63	60.3
Motao	29	34	63	19	27	46	73.0	148	31.1
<b>Total</b>	<b>255</b>	<b>255</b>	<b>510</b>	<b>163</b>	<b>155</b>	<b>318</b>	<b>62.4</b>	<b>1,225</b>	<b>26.0</b>

Overall assessment showed that among the 150 families that were investigated, 81 had two children or more who contracted measles during the epidemic. In 56 of these families (69 per cent) the oldest child was first to be infected.

A few sporadic cases occurred among children of plantation workers. According to another plantation manager, no epidemic occurred in two of the Sangha River villages to the immediate south.

#### Discussion

The source of the Kouapouli epidemic was probably the coffee plantation workers who constitute the most frequent "outside" contact for the villagers. These workers come from as far away as the Chad border. They work for a few weeks or months before returning home or leaving for diamond prospecting in regions to the north and are constantly replaced by other workers and their families. Plantation workers have been recruited steadily into the area over the past 40 years and provide a continual, potential source for the importation of measles (or any other disease).

In view of this constant possibility for exposure to measles, it is surprising that measles in Kouapouli had not occurred previously, with greater frequency and lesser intensity. The coffee plantation manager had observed no such outbreaks for the ten years he had been in the area. Likewise, a missionary who had been working in the Nola subprefecture for several years had witnessed no such outbreaks.

#### Conclusion

In Kouapouli, the reservoir of susceptibles that had built up over the years was unusually large. During the epidemic, 57.5 per cent of the cases occurred in children older than three years of age. In West Africa as a whole, measles epidemics are characteristically spaced no more than three years apart, and the age distribution of cases is definitely concentrated in the

younger age groups. On the other hand, the age distribution of cases is generally found to vary with population density. In an area as remote and with as low a population density as Kouapouli, a low occurrence frequency of measles epidemics would not be unusual.

Furthermore, in the Kouapouli epidemic, the majority of measles deaths (76.2 per cent) occurred in children under the age of three years. The highest age specific case fatality rates were reported in children aged two years or younger. This is consistent with findings throughout the other West African countries.

(Reported by Bernard Durand, M.D., Directeur du Service des Grandes Endemies, Central African Republic; Neal H. Ewen, C.A.R. Smallpox/Measles Program; and Smallpox Eradication Program, NCDC.)

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\*The Vesicular Disease Laboratory of the Viral Exanthems Unit, Laboratory Program, bears responsibility for all smallpox-related laboratory activities and is a vital component of the NCDC Smallpox "team".

Listed below are officials responsible for Smallpox Eradication Activities in countries participating in the West African Regional Smallpox Eradication/Measles Control Program. Their contributions to this report are greatly appreciated.

#### REGIONAL HEALTH ORGANIZATIONS

OCCGE—Médécin Général Pierre Richt, Secrétaire Général  
Dr. Cheick Sow, Député Secrétaire Général  
OCEAC—Médécin Col. René Labusquière, Secrétaire Général

##### Cameroon

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Deputy Director of Health  
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##### C.A.R.

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##### Chad

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Directeur du Service des Grandes Endémies

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Dr. Maximilien Yekpé  
Médécin-Chef du Secteur Sud

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Inspecteur du Service des Grandes Endémies

##### The Gambia

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Dr. Peter N'Dow  
Deputy Director of Medical Service

##### Ghana

Dr. Francis C. Grant  
Senior Medical Officer (Epidemiology)

##### Guinea

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Directeur de l'Institut d'Hygiène

Mr. D. K. Bitty  
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Smallpox-Measles Program

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Direction Nationale de la Santé

Dr. Benitiani Fafana  
Direction Nationale de la Santé

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Ministre de la Santé et des Affaires Sociales

Dr. Leon Tchelle  
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Médecine Mobile

Dr. Louis Chamorin  
Conseiller Technique  
Directeur du Service National d'Hygiène et de la  
Médecine Mobile

##### Nigeria

Dr. E. Ademola Smith  
Director, Nigeria Smallpox-Measles Programme for  
Permanent Secretary  
Federal Ministry of Health

##### Senegal

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Directeur de la Santé

Dr. Makhone Seck  
Directeur du Service des Grandes Endémies

Dr. Amadou Sy  
Médécin-Chef du Service d'Hygiène

Dr. P. Gbezo  
Directeur Adjoint du Service d'Hygiène

##### Sierra Leone

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Acting Chief, Endemic Disease Control Unit  
PMO Office

Dr. Evelyn Cummings  
Deputy Chief, Medical Officer  
Ministry of Health

##### Togo

Dr. Leopold Prince-Agbodjan  
Chef, SHMP

##### Upper Volta

Dr. Pierre Compaore  
Directeur des Santé's Ruale

COUNTRY ASSIGNEES

Country	AID Representative	NCDC Medical Officer and Operations Officer*
CAMEROON—Yaounde	John C. McLaughlin AID Operations Officer	Bruce H. Peters, M.D. John McEnaney
CENTRAL AFRICAN REPUBLIC—Bangui	Charles S. Gordon AID Operations Officer	Neal Ewen
CHAD—Ft. Lamy	Roy A. Harréll, Jr. AID Operations Officer	Russell S. Charter
DAHOMEY—Cotonou	Robert M. Beckman Act. AID Operations Officer	Jeannel Roy
GABON—Libreville	Richard J. Delaney Acting AID Assistant Operations Officer	Jay Friedman
GAMBIA—BATHURST	Henry Uznanski AID Operations Officer	Robert C. Helmholtz Lesley M. Jenkins
GHANA—Accra	Richard M. Cashin Director, USAID	David Melchinger, M.D. M. David Newberry
GUINEA—Conakry	K. Fred Carpenter Acting AID Affairs Officer	Joel Breman, M.D. Donald Malberg
IVORY COAST—Abidjan	Michael A. Codi AID Operations Officer	Harry R. Godfrey
LIBERIA—Monrovia	John A. Ulinski, Jr., Mission Director, USAID	David Thompson, M.D. Dennis Olsen
MALI—Bamako	Stanley Clark AID Operations Officer	Pascal J. Imperato, M.D. Mark LaPointe
NIGER—Niamey	Brian Wickland AID Operations Officer	Logan H. Roots, M.D. Anthony R. Masso
NIGERIA—Lagos (Federal)	Michael H. B. Adler Director	Stanley O. Foster, M.D. James E. Donohue
NIGERIA—Benin	---	Paul A. Bond
NIGERIA—Ibadan	---	Lloyd Wade
NIGERIA—Kaduna	---	Richard B. Arnold, M.D. John Pifer, M.D. Robert N. Evans Robert C. Hogan Clara J. Jones William Shoemaker
SENEGAL—Dakar	Henry M. Uznanski AID Operations Officer	Robert C. Helmholtz Lesley M. Jenkins
SIERRA LEONE—Freetown	Newman Jeffrey AID Operations Officer	Donald Hopkins, M.D. James Thornton
TOGO—Lome	Allan E. Dean AID Operations Officer	Andrew N. Agle
UPPER VOLTA—Ouagadougou	Irving H. Licht AID Operations Officer	Christopher D'Amanda, M.D. Thomas A. Leonard

\*Listed alphabetically by specialty

The first part of the document  
 discusses the general principles  
 of the system and the  
 various methods of  
 application. It is  
 intended to be a  
 practical guide for  
 the student. The  
 second part of the  
 document contains  
 a list of the  
 various methods of  
 application. It is  
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